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ELECTRONIC APPARATUS FOR THE DIRECT REGISTRATION (Recording) OF A COMBINED CIRCULATION-METABOLISM TEST IN DAILY PRACTICE

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SUMMARY

We will report on a newly developed electronic measurement device with which it is possible to register the systolic and dyostolic blood pressure as well as pulse and frequency of breathing. The recording corresponds to the scheme of the well-known Schellong Tests. A single assistant can make the measurements and are completely objective. After a suitable codification by means of a simple diagram atlas, this test produces a practical contribution for the automatic evaluation of a diagnosis. The apparatus is also suitable for a succession of examinations.

I INTRODUCTION

The general, usual, unique measurements of blood pressure and pulse frequency used in daily practice supply only an unsatisfactory contribution for the determination of the condition of the patient's circulation. The individual measurements found are, on one hand subject to the subjective mistakes on the part of the physician and on the other hand are influenced by the psychological tensions at the moment of the measurement.

Considerably more illuminating is a circulation-metabolism test according to Schellong, whereby generally after physical exertion 10 single measurement of pulse frequency are determined at minute intervals. For the execution of the Schellong tests according to the stated technique, one physician and one to two assistants are needed.

By means of the described apparatus this test can be completely objectively executed by one single assistant. The examination diagram is drawn-up (shown) directly and it is further possible to determine the atem* frequency automatically on the same recording tape.

It is possible, without any difficulty, to execute further tests such as the "One or two-step-test" or the so-called "Cold Pressure Test" with this instrument.

The measurement of the blood pressure id done without blood (bloodlessly) according to the method of Riva-Rocci by means of the upper arm-cuff.

* Must be "breath" - typing error possible here

The writing instrument of the registration apparatus is moved directly over a pneumatic system by means of the pressure of the cuff. By means of a special microphone the Korotkoff tones are recorded in the usual manner above the cubital artery. The recording instrument which runs from right to left across the recording paper during the decreasing air pressure, marks a point on the registration paper for every Korotkoff tone. The point which is recorded first represents the systolic point and the point drawn-up last denotes the dyastolic blood pressure. The connecting line of these end points which is to be made by hand after the recording is finished, gives the pattern of the blood pressure according to Sahellong.

During every single measurement of blood pressure a condenser is set-up over a step switch relay after a certain number of Korotkoff tones i.e. pulse waves. This tension which is immediately stored up on the condenser is a measurement for the pulse frequency. This stored-up tension is compared to an indication of a proportional tension of the recording instrument during the inflation phase of the cuff and the corresponding recording mark of the pulse frequency is shown in the moment of equal tension. These measurement marks are united with each other after the measurement is finished just as the markings for the maximum and minimum values of the blood pressure; here however, the marks for the pulse frequency have to be placed before hand at the moment (point of time) of the corresponding blood pressure registration.

Finally, the breath frequency is shown analogically to pulse frequency during which time the breath impulse giver consists of a simple contact giver which is activated by the breath stream of the patient.

II Details of Construction

The schematic construction lets us recognize the individual construction of the instrument.

The pneumatic writing system is directly coupled with the pressure cuff and can be filled with air pressure in the well-known way by means of a rubber bulb. The deflation is made possible through pressure valves, which enable one to choose different speeds for the deflation. After inset of the first Korotkoff tone one should lessen the speed of the deflation to such a degree that approximately 10 Korotkoff tones reach the recording.

However, an automatically working additional-instrument with a compressor can be connected. The regulation of the inflation and deflation of the cuff

is accomplished with an automatic device on the one hand through the end contacts which are placed on the final marks of the recording instrument, and on the other hand through a time switch mechanism for the determination of the spaces for the individual measurements. The instrument has two areas of measurements

0 .... 180 mm Hg and

0 .... 360 mm Hg

as well as a uniform pulse frequency-measurement-area 40 . . 180 beats per minute and a breath-pulse-measurement area of 10 . . 40 breaths per minute which is connected to the pulse-frequency-measurement area 40 . . 180 beats per minute. According to this method only a unified pressure is necessary.

Of extreme importance during the measurement is the secure position of the patient's arm which is achieved by having some form of support.

The Korotkoff microphone as it has been used most recently consists of an open capsule which is placed over the cubital artery and also (consists of) a crystal microphone which is attached to an adjustable stand, whereby the capsule is connected with the microphone through a hose. By this means the fricative sounds are few.

The cuff remains strapped on the patient during the charge.

The strengthened Korotkoff tones guide the relay Rel. 1 whose termination is proportional to the intensity of the Korotkoff tones.

By means of an earphone the quality of the Korotkoff tones can be determined. Moreover, the described apparatus is construced in such a way that it can be used as an electric stethoscope at the same time.

The condenser C_p which serves for the pulse measurement is loaded over the step-switch-relay Rel. 2 during the duration of three switch-steps. The tension of the condenser, which is a measurement for the pulse frequency is compared to tension U_v by means of tube T 1. The tension U_v is turned on by potentiometer P which is connected to the axis of the recording instrument. The line of demartation of this potentiometer is set up in such a way that the pulse frequency is shown linearly. During equal tension Pol. relay Rel. 3 switches on and registers the pulse frequency.

The instrument which gives the breath frequency consists of a foil which is moved by the breath stream of the patient; this foil is furnished with a contact equipment. This instrument is moved back and forth in front of the patient's mouth and does not bother him. The contact regulates a flip-flop

switch which switches relay Rel. 4 whereby the recording analogous to the pulse frequency recording on the scale area 10 -40 is accomplished (relay Rel. 5). At the scale value 40 the switching over the breath frequency condenser C_B is accomplished automatically on the pulse frequency condenser C_p by means of relay Rel. 6.

Moreover, point marks can be written on the edge of the recording paper by means of a special writing instrument; these point marks note the individual phases of the circulation test and are put in by hand.

For the correct termination of the entire recording sequence, and for the correct automatic regulation some additional relays and various switch contacts are necessary which are not presented here, that is, are not explained here, for example the preparation for the zero position of the step-switch relay, needs contacts for the pointers, switch contacts for relay Rel. 6 and so forth.

The accuracy of the inset of the recording instrument is guaranteed through the fact, that during the measurement procedure the recording instrument vibrates slightly. By this method tendancels of remaining in the same place, that is particularly relating to jerky movement of the instrument (pointer) is ruled out.

The apparatus is approximately the size of a portable typewriter.

III APPLICATIONS

The example of registration shows the characteristic procedure of the circulation test on a patient with a hypotoen disturbance in the metabolism during the Stehversuch attempt.

By the number of disturbances in the metabolism, the test first of all turns out uncharacteristically. The largest number of these are the cases which have a complete slip of the vegetative metabolism. The simple carrying out of the test justifies however, by such patients the carrying out of a greater number of measurements after certain provocations, for example the provocations of a medical or physical nature.

The indirect measurement of blood pressure by means of a cuff gives, in most cases, a very satisfactory correlation with the blood pressure values which have been measured directly. The procedure becomes useless only by very small amplitudes of blood pressure during which the Korotkoff tones become very weak. The indirect method generally measures a diastolic blood pressure value which is too small when large blood pressure amplitudes are concerned.

This small percentage of patients to whom the described method cannot be applied will be subject to special examinations.

With consideration of this limitation the test represents an important foundation for the judgement of the condition of the circulation of a patient. Moreover, after necessary codification it is a useful contribution for a controlled evaluation of a diagnosis; an evaluation whereby the codification can take place through comparison of the recording tape with a simple diagram atlas.

The simple handling of the apparatus is ideal for a succession of circulation examinations. Therefore, it can serve as a [illegible] for the classification and early discovery of disturbances in the metabolism.